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SOUTHERN AFRICA ENERGY PROGRAM (SAEP)

DRIVING IMPACT THROUGH CONNECTIONS IN MOZAMBIQUE

Discussion document | September 2019

MOZAMBIQUE PATH TO IMPACT

CONTEXT AND OBJECTIVES

Context

- SAEP aims to increase investment in electricity supply and access in Southern Africa by strengthening the regional enabling environment and facilitating transactions
- A key success indicator for SAEP by 2022 is to deliver **3 million connections**
- SAEP aims to ramp-up support to Mozambique as of Year 3 given the potential connections at stake (~300,000 based on an outside-in assessment)
- To validate this opportunity, SAEP initiated a "Path to Impact" analysis, that started with a **visit to Mozambique on 26-28 June 2019**

Objectives of this document

- Perspective on strategies to deliver off-grid connections in Mozambique in 2019-2022, based on:
  - The **status of electrification** in Mozambique and future access projections
  - An **overview of key institutions and activities** in the sector
  - Possible **areas of intervention** for SAEP
  - **Syndication** of possible interventions with stakeholders
  - **Details** of identified interventions
- In addition, it provides a view of immediate **next steps**

MOZAMBIQUE PATH TO IMPACT – EXECUTIVE SUMMARY (1/2)

Electrification in Mozambique	▪ Mozambique is the **27th largest economy** in Africa, with a **population of 29.5 million** and GDP of USD $14.5 billion ▪ However, it is **one of the poorest** (GDP/capita USD $490) and **most rural** (64%) countries on the continent ▪ Today, approximately **4.1 million** Mozambican households have **no access to electricity –** those with access (1.89 million) are concentrated in urban Maputo; **rural access** is low at **6%**. ▪ **Authorities aspire** to increase annual electrification rates by four fold to 530,000 connections per year in order to **attain universal access by 2030** – an **ambitious target** given funding requirements and operational capacity ▪ Therefore, **off-grid has a key role** in providing access to power to areas without grid by 2023 ▪ The immediate **addressable SHS market is estimated at 600,000 households** concentrated in Nampula and Zambezia, where population is dense and access rates are low, and Tete and Cabo Delgado – areas far from the grid where affordability is relatively high
Structure and institutions	▪ **Key institutions** in the off-grid sector are the Ministry of Energy (**MIREME**), the utility (**EDM**) the rural electrification agency (**FUNAE**), and the renewable energy industry associations (**AMER** and **ALER**) ▪ Recent **reforms encourage off-grid**, including the **Electricity Act** which will allow for private participation in mini-grids, and the **National Electrification Strategy** which anticipates a 19% share of off-grid power by 2030 ▪ **Four** prominent private sector **SHS providers** have **recently entered** the market – SolarWorks!, Epsilon, Ignite and Fenix – collectively **aspiring** to deliver **700,000 connections by 2023**. However they face **key barriers to scale**, including low visibility of consumer affordability and optimum route to market, no VAT exemptions on SHS components, and high cost of finance. Only one, Ignite, has an agreement with FUNAE to deliver 300,000 SHS connections ▪ **Four key development partners** engaged in the off-grid sector are DFID (BRILHO), Embassy of Sweden (BGFA), World Bank (ProEnergia) and Belgium (RERD)

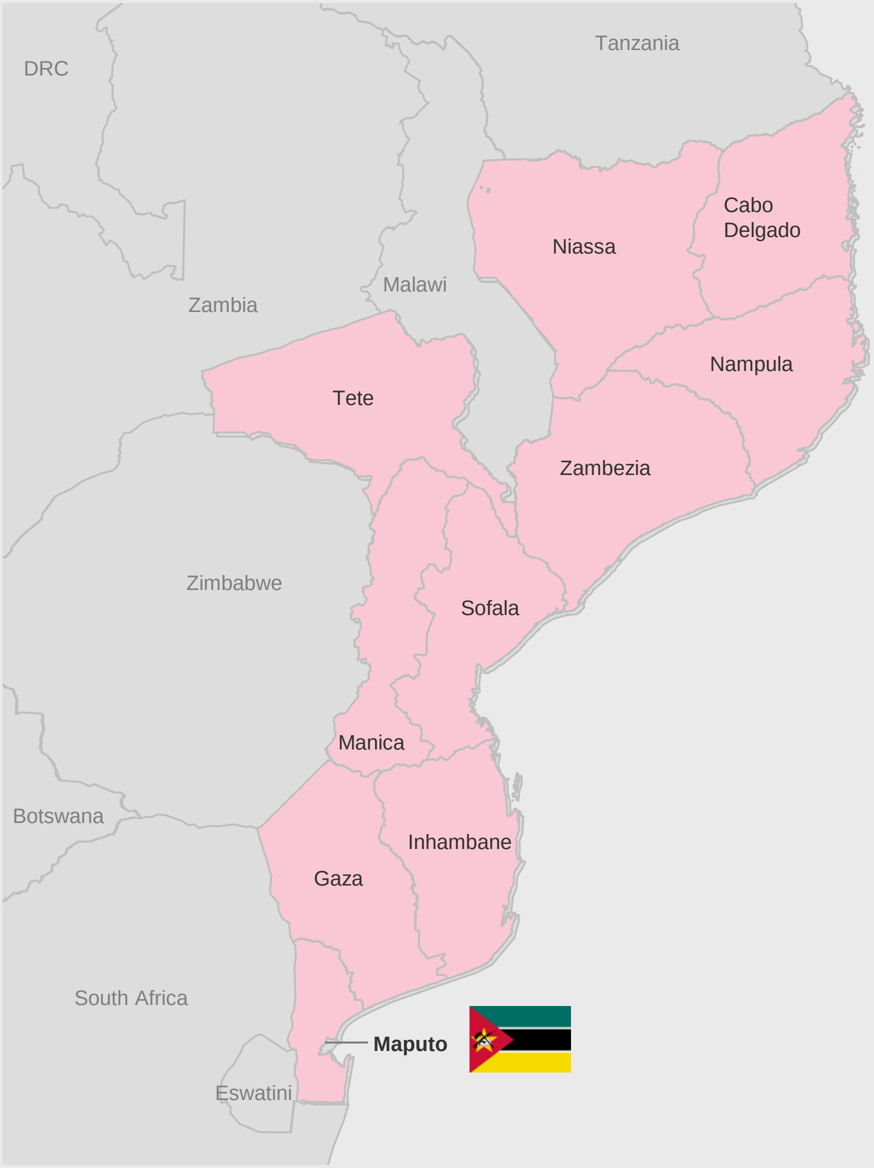
MOZAMBIQUE PATH TO IMPACT – EXECUTIVE SUMMARY (2/2)

Path to impact for SAEP

- Private sector **SHS scale-up support provides the best opportunity** for impact of the various options analyzed with **100,000-300,000 connections at stake**
- While other programs ramp up, **SAEP can immediately help SHS companies** through **two key initiatives** that will help **address root causes of slow ramp-up** for the SHS companies:
  - Improving ability of SHS companies to make effective **route to market** decisions
  - Creating transparency over **consumer affordability**
- During Year 3, SAEP will also **continue to explore** the following, **for Years 3 and 4:**
  - **Supporting BGFA** design and plan an RBF scheme in Mozambique
  - Providing **operational support** to SHS companies, based on need
  - Supporting SPEED+ in driving processes to **remove high VAT and import duties** on solar power products
  - **Providing technical analysis** to support the **Inter-Ministerial Committee and Implementation Coordination Group**
  - Supporting regulatory change to **enable private sector** in the **mini-grid** space
- In parallel, SAEP will engage **Cooperating Partners** (EnDev, EU, BGFA, BRILHO, World Bank) to identify **opportunities for collaboration**, **programmatic gaps** in the sector

MOZAMBIQUE PATH TO IMPACT

MOZAMBIQUE IS THE 27TH LARGEST ECONOMY IN AFRICA, WITH A POPULATION OF 29.5M PEOPLE AND A GDP OF USD $14.5 BILLION



29.5m people, 14th most populous country in Africa (out of 54)

USD $14.5b GDP, 27th largest economy in Africa, growing at **~3.3%**

Reducing inflation rates, currently at **3.5%**

SOURCE: World Bank World Development Indicators 2018, Central Bank of Mozambique website 2018

HOWEVER, MOZAMBIQUE IS ALSO ONE OF THE POOREST AND MOST RURAL COUNTRIES ON THE CONTINENT

7th highest poverty rate in Africa[1]

- **63%** of the population live **below the international poverty line** i.e., on less than USD $1.90 PPP per day (compared to 58% in Zambia)
- **6th lowest GDP per capita in Africa** of **USD $490** (a third of Zambia's at USD $1,540)
- **Insecurity** has been **on the rise in the north** with a surge in incidents since 2017[2]

Top 20% wealthiest households consume…

…what the bottom 40% consume

Sparse rural population

- The country's **main contributor** to GDP remains the **agricultural sector** (21% of GDP)
- However **8 out of 10** of Mozambique's **poor** are in **rural areas**

- **Poor road conditions**, connectivity, and the long distances between project sites and major ports remains a **major distribution and maintenance challenge**

Mainly rural population with low spending power and willingness-to-pay

1 Based on USD $1.90 at PPP per day, the international poverty line. NB this data is collected separately for each country and is dependent on when the last update was conducted. For Mozambique this was 2014, and for Zambia it was 2015. 2 See appendix for more information

SOURCE: World Bank Mozambique Poverty Assessment (November 2018); World Bank World Development Indicators database 2018; World Bank Mozambique Data capsule

TODAY, APPROXIMATELY 4.1 MILLION MOZAMBICAN HOUSEHOLDS HAVE NO ACCESS TO POWER, WITH 6% ACCESS IN RURAL AREAS

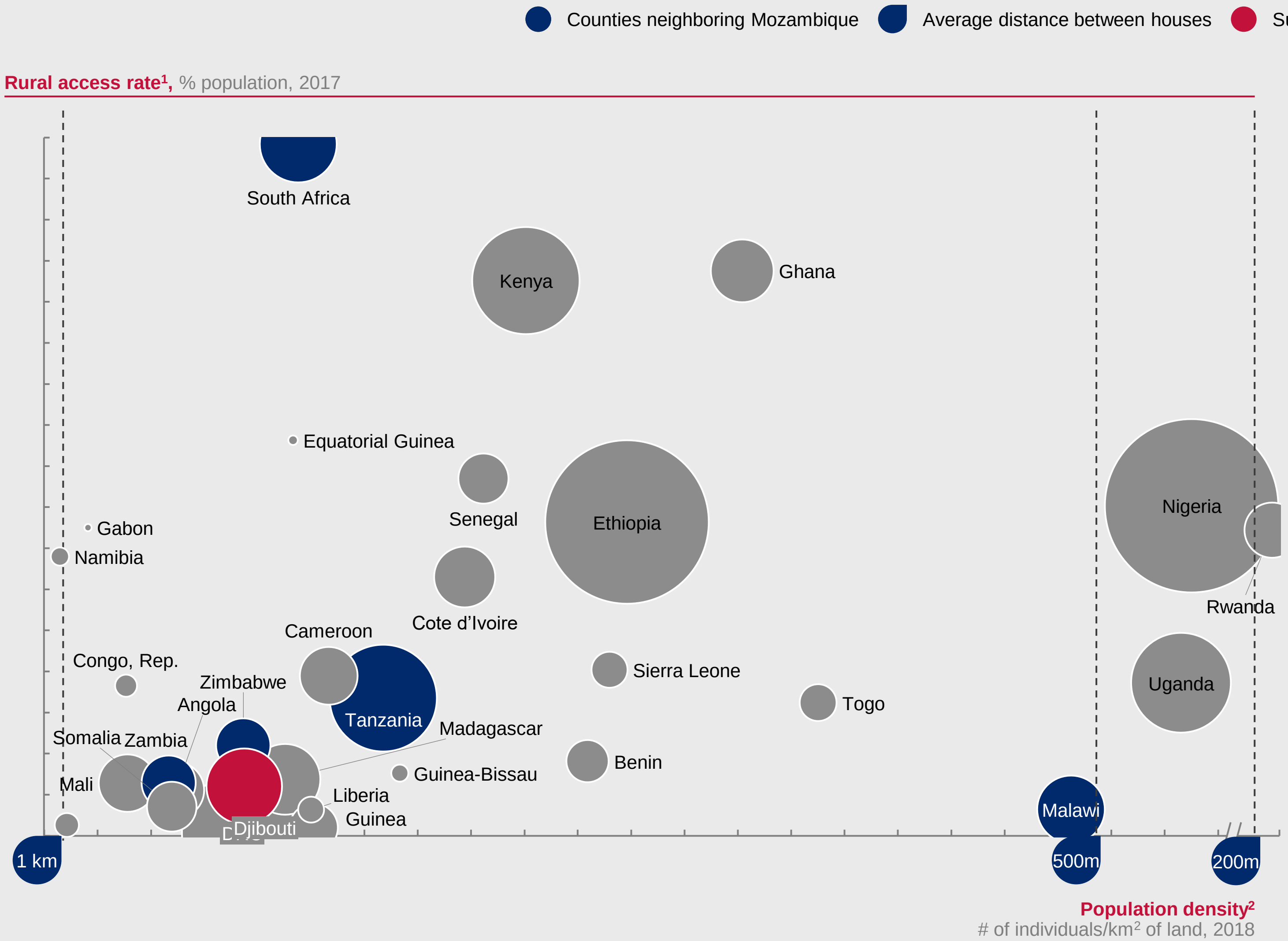
Urban / Rural

	Geographic split of households[1] % HH, 2017 (unless otherwise indicated): Urban	Rural	Current access rate[2] (%): Urban access	Rural access	Un-electrified households[3] M HH: Rural	Urban	Total
Mozambique (2018)	36	64	54	6	3.1	1.0	4.1
Madagascar	37	63	52	7	3.0	0.9	3.9
Angola	65	35	69	6	2.4	1.4	3.8
Malawi	17	83	49	3	3.0	0.3	3.3
Zambia	43	57	67	6	1.8	0.5	2.3
Zimbabwe	32	68	81	11	2.0	0.2	2.2
South Africa	66	34	84	84	0.6	1.2	1.8
Lesotho	28	72	63	24	0.2		0.3
Namibia	49	51	78	34	0.2		0.2
Botswana	69	31	69	32	0.1		0.2
Eswatini	24	76	90	71	0		0.1

1 World Bank World Development Indicators urban and rural population as a percentage of total population
2 IEA OECD World Energy Outlook, Energy Access database - 2018
3 Mozambique numbers are for 2018 as data was available from World Bank ProEnergia Appraisal report published March 2019

SOURCE: World Bank WDI database 2018, IEA OECD 2018 WEO Electricity Access database

MOZAMBIQUE ACCESS AND DENSITY RATES ARE MORE SIMILAR TO ZAMBIA THAN MOST OTHER SAEP COUNTRIES

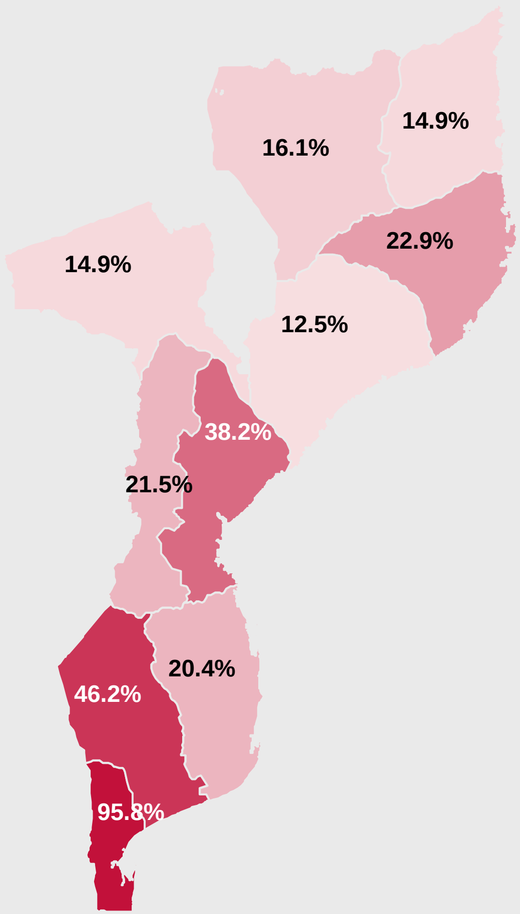


- Mozambique has both very **low rural access rates and sparse populations,** making **cost of grid extension very high**
- In addition, **very sparse road networks** further increases cost of grid extension
- Logistical challenges and funding requirements have **implications on how quickly grid can be extended**

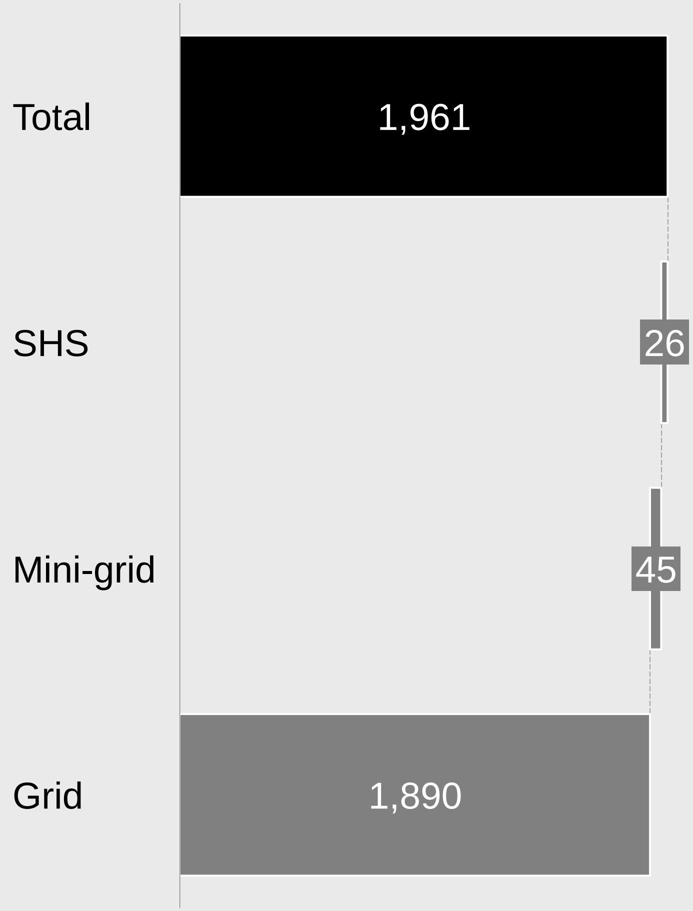
1 IEA OECD 2018 World Energy Outlook Electricity Access database; 2 World Bank World Development Indicators 2018

THOSE THAT DO HAVE GRID ACCESS (1.89 MILLION HOUSEHOLDS) ARE CONCENTRATED IN URBAN MAPUTO

Access rate per province



Connections by type[1], '000



- Grid connections are concentrated in the South, with Maputo having an access rate of 96% or **~770,000 connections[2]**
- There are currently **~24,000 SHS** customers of private sector companies
- FUNAE has been able to electrify **nearly 300 villages through mini and micro-grids** as well as provide **1,744 SHS** that allowed electrification of 235 villages, 600-800 schools and 600-700 health centers[3]

1 Assumes ~150 connections per mini-grid site; 22,000 SHS connections by SolarWorks!, 2,000 by Epsilon and 1,744 by FUNAE; 2 Calculated using current electrification rate in Maputo and Maputo City (95.8% and 81.3% respectively) multiplied by number of households (613,648 and 224,796 from 2017 Population census) – Maputo and Maputo City have been added together for simplification; 3 Numbers reported vary from 580-799 schools and 561-710 clinics

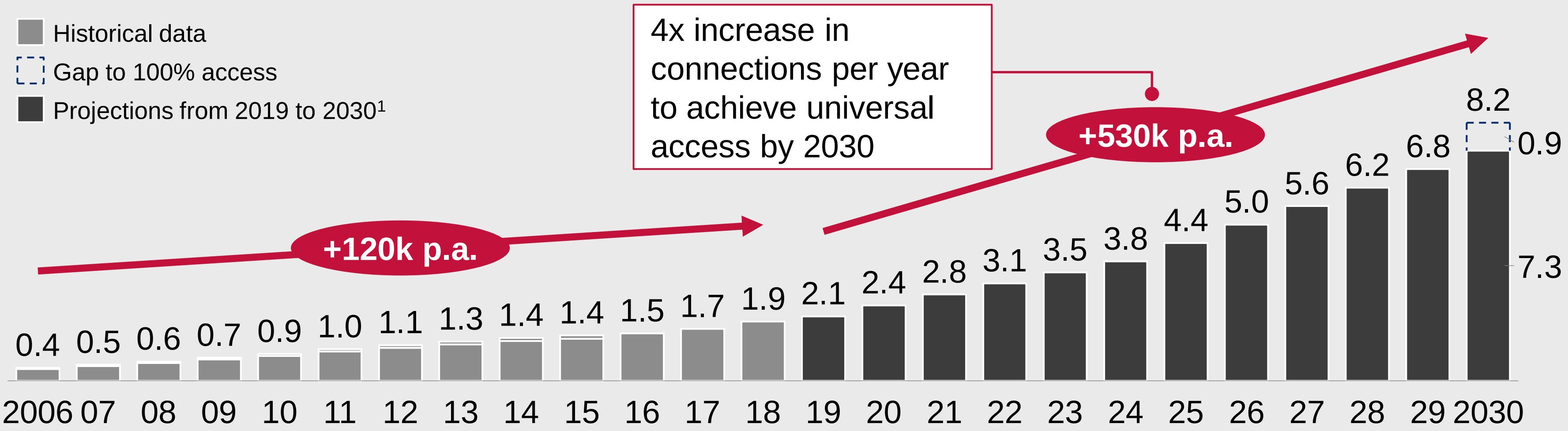
SOURCE: World Bank Mozambique ProEnergia Appraisal report - March 2019, ESMAP - Mozambique Geospatial Options analysis towards universal electrification; Mozambique 2017 population census (INE website); SolarWorks! Presentation; Interviews

AUTHORITIES ASPIRE TO MORE THAN DOUBLE ELECTRIFICATION RATES P.A. BY 2030 IN ORDER TO ATTAIN UNIVERSAL ACCESS

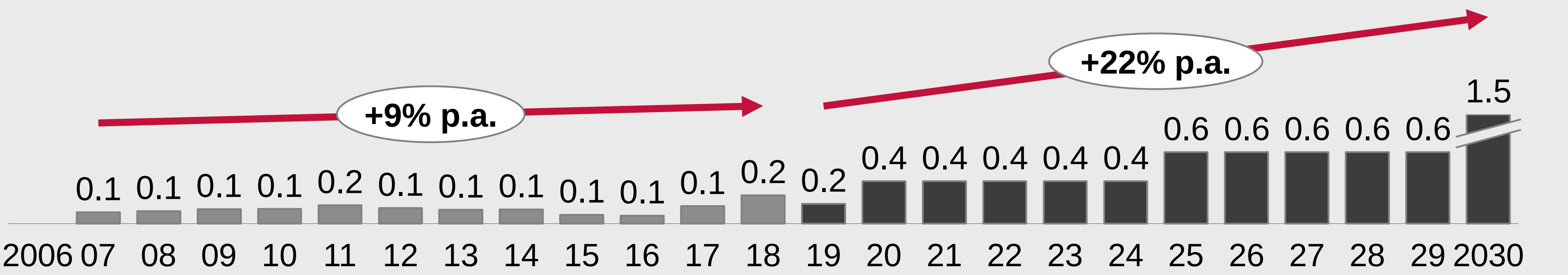
Increase in number of annual connections

Average additional connections per annum

Grid electrification, *absolute number of connections, millions*[1]



Grid electrification, *annual number of connections, millions*

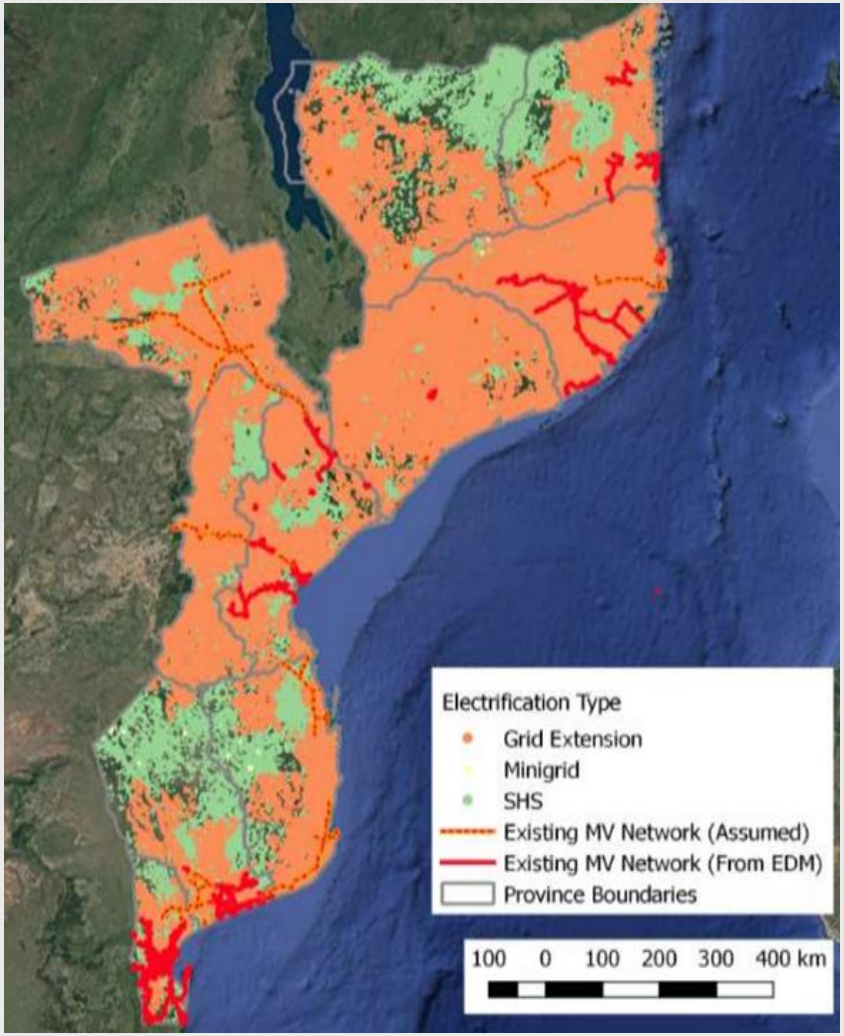


1 Assumptions from WB and National Electrification Strategy (NES): Electricity connections will need to ramp up from 120,000 a year in 2018 to 530,000 on average between 2019 and 2030 to achieve universal access, with an estimated investment of USD $6.5 billion

SOURCE: EDM Statistics (in NES), EDM Statistics (World Bank, March 2019, Mozambique ProEnergia Appraisal report), World Bank WDI database 2018

DESPITE ASPIRATIONS TO PROVIDE UNIVERSAL GRID ACCESS, OFF-GRID HAS A ROLE IN PROVIDING ACCESS IN THE NEAR TERM

Projected distribution of connections

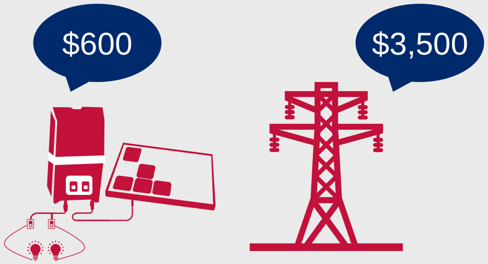


Preliminary analysis from the Mozambique Geospatial Options Analysis funded by ESMAP

- **14%** of the population (**4 million people**) are **close enough to the grid** such that grid extension would be financially viable
- **Areas not currently served** by EDM **could be served** either by **extending the grid** (requiring investments in transmission and distribution), **mini-grids or SHS**

SOURCE: ESMAP Mozambique Geospatial Options Analysis towards Universal Electrification.

OFF-GRID HAS A KEY ROLE IN PROVIDING ACCESS TO POWER IN THE AREAS THAT WILL NOT BE CONNECTED BY 2023



SHS connection cost per household for is estimated to be **~USD $600**[1] in Mozambique – compared to the **~USD $1,000 to $3,500**[1] for a grid connection

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Current energy expenditure levels indicate an addressable market of ~600,000 households (10%) for SHS – across **Maputo, Nampula, Zambezia, Tete and Cabo Delgado**[2]

Assuming **20%**[3] of those who can afford SHS **actually adopt**, this is ~120,000 potential connections

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To **achieve ~300,000 to 400,000 SHS connections** in the next 3-4 years, affordability of SHS should be improved by USD ~$1.42[4] per month or 19%

1 Cost estimates from GGGI and SAEP Zambia Least cost geospatial analysis; 2 See subsequent pages for analysis; 3 This 20% adoption rate is based on experience from 3 stakeholders in Malawi; it could be up to 50% in Mozambique, as per anecdotal reports in Mozambique; 4 With a 50% adoption rate, to reach 400,000 HH, the addressable market would need to be 800,000, requiring quintile 3 to be able to afford SHS. Average monthly spend of quintile 3 is USD $6.08 (see next page);

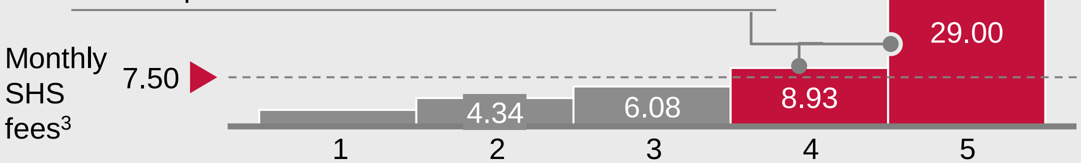
SOURCE: Global Green Growth Institute (GGGI) 2019: Off-grid solar power in Mozambique opportunities for universal energy access and barriers to private sector participation

ENERGY EXPENDITURE LEVELS INDICATE A SMALL ADDRESSABLE MARKET OF ~0.6 MILLION HOUSEHOLDS FOR SHS

Monthly SHS fee above spend | HH that can afford SHS (monthly SHS fee within spend) | HH without electricity that can afford SHS

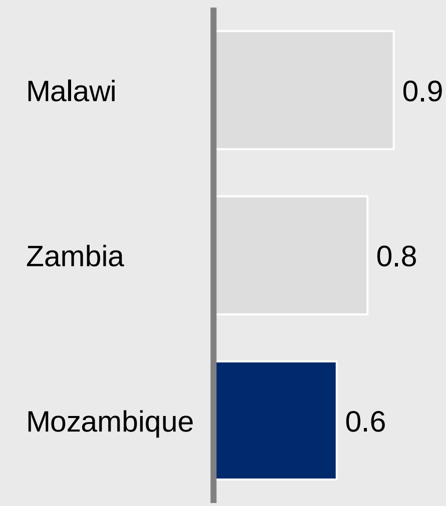
Average monthly household (HH) spend on energy per income quintile,[1,2] USD $

- **1.5 million HH can afford SHS** – they spend over USD $7.50 per month on lighting
- However, **0.8 million** of these **have electricity** or solar panels



		1	2	3	4	5
A	**# HH per quintile[4]**, million	1.31	1.18	1.04	0.87	0.66
B	**HH with electricity/ solar for lighting, by quintile[4]**, %	8.6	13.5	22.8	38.5	74.3
C (A x B)	**# HH with electricity/solar for lighting by quintile**, million	0.11	0.16	0.24	0.33	0.49
D (A - C)	**# HH without electricity**, million	1.20	1.02	0.80	0.53	0.17

Addressable market, HH million



- Based on this analysis the **addressable market** for SHS is **0.7m HH**
- **However, 14% (0.08 million)** of these HH are **close to the grid** and most likely to be connected in next 5-7 years
- The resulting addressable market is then **~0.6 million HH**

1 Income quintiles from bottom (1) to top (5); 2 Fenix assumption of 8% average spend on energy;
3 Monthly fee is based on syndication with all 4 SHS companies in Mozambique; 4 Family Budget Survey Mozambique, 2014/15

SOURCE: Mozambique National Electrification Strategy Draft 2017, Family Budget Survey 2014/15; WB Mozambique Appraisal report 2019

MOZAMBIQUE PATH TO IMPACT

OVERVIEW OF THE KEY INSTITUTIONS IN THE OFF-GRID SECTOR

Role	Institution	Responsibilities[1]
Policy	**Government of Mozambique**	▪ Setting **national targets** and energy **sector policy**, instructs for law of decree creating the Electricity Account
Planning	**MIREME (Ministry of Mineral Resources and Energy)**	▪ Translating Government of Mozambique policy and **defining projects**, setting **intermediate objectives** to meet national targets and policy objectives
	DNEE (The National Directorate for Electrical Energy)	▪ Is a central **technical body** within MIREME, responsible for the analysis, preparation and elaboration of energy policies
Financier	**MEF (Ministry of Economy and Finance)**	▪ Supervising and **controlling FUNAE** ▪ Under NES, it will be responsible for **managing funds** for electrification projects outside of EDM areas
Regulator	**ARENE[2]**	▪ Regulates the sector, including **proposing tariffs** and **legislation**, promoting competition and **quality control**
Associations	**AMER[3]**	▪ Non-profit association which **promotes renewable energy** in **Mozambique**
	ALER[4]	▪ Non-profit association which **promotes renewable energy** in **Portuguese-speaking countries**
Facilitator	**FUNAE (Fundo de Energia)**	▪ Acts as a **Rural Electrification Agency** and facilitator for rural off-grid connections, with a **USD $500 million** Renewable Energy **portfolio** ▪ Responsible for setting **standards for off-grid power**

1 For more details, see appendix; 2 Autoridade Reguladore De Energia; 3 Associação Moçambicana de Energias Renováveis (AMER); 4 Associacao Lusofona de Energias Ronovaveis (ALER)

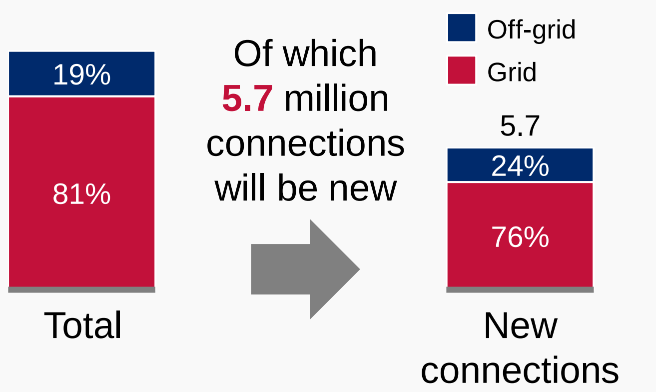
SOURCE: National Electrification Strategy – November 2017; ALER Energias Renováveis em Mocambique, October 2017; Integrated Master Plan - Mozambique Power System Development – November 2018

RECENT REFORMS HAVE SOUGHT TO ENCOURAGE OFF-GRID PARTICIPATION TOWARD ACCESS

Reforms in the energy sector

Legislation/ policy	▪ National Electrification Strategy	▪ Amendment to the Electricity Act[1]	▪ Fiscal policy
Timeline	▪ Released in **2019**	▪ Due to pass in **2020**	▪ Under discussion
Reform details	▪ Targets **19% off-grid connections**, with 24% of new connections being off-grid between now and 2030	▪ **Will allow private sector participation** in import and export of electricity, electricity consumption and energy services ▪ **Essential pre-requisite** for private sector participation in **mini-grid development** in Mozambique[2]	▪ **SHS are subject to 17% VAT and 7.5% import duty** (perceived as primarily protecting domestically produced components, particularly by FUNAE) ▪ **Discussions are underway regarding exemptions**

Targets for 2030, *million connections*



1 Completed public consultation in February 2019, set for review during the next Parliamentary session and due to pass in 2020
2 Mini-grid operators will still be required to charge a national tariff

SOURCE: National Electrification Strategy 2019; GGGI Country Brief Mozambique 2018; Engineering News “Ministerial approval for new Mozambique Electricity Law pending””- April 2019;

FOUR[1] KEY DEVELOPMENT PARTNERS IN THE OFF-GRID SECTOR ARE DFID, EMBASSY OF SWEDEN, WORLD BANK AND BELGIUM (1/2)

(X) Ranking of 4 programs in Mozambique with highest budget in off-grid energy[1]

NOT EXHAUSTIVE

		Financing	Technical assistance				
Overall			**WB:** National Electrification Strategy (3)		**GIZ (EnDev):** Tax reform		**USAID (SPEED+):** Tax reform; NES, Electricity Act
Enabling environment	**MIREME**		**DFID (BRILHO):** Policy reform and institutional strengthening (1)	**EU:** Targeting MIREME and possibly ARENE. Supporting establish-ment of AMER	**GIZ/ (EnDev):** Capacity building	**Belgium (RERD):** Capacity building (4)	**USAID (SPEED+):** Steering approach
	ARENE				**Norwegian Embassy:** Capacity building		
	AMER						
	ALER						
	FUNAE	**WB:** USD $3m grant for management and strategy (3)		**EU:** Targeting FUNAE	**GIZ (EnDev):** Capacity building; Task Force lead	**Belgium (RERD):** Capacity building (4)	**USAID (SPEED+):** Steering approach

1 According to the World Bank Project Appraisal Document which states the donor programs and funding: DFID (BRILHO) with USD $30m, Embassy of Sweden with USD $17.5m, World Bank with USD $16m and Belgium (RERD) with USD $13.8m

SOURCE: World Bank 2019, ProEnergia Project Appraisal Document; DFID 2017 Energy Africa Compact; Interviews with development partners

FOUR[1] KEY DEVELOPMENT PARTNERS IN THE OFF-GRID SECTOR ARE DFID, EMBASSY OF SWEDEN, WORLD BANK AND BELGIUM (2/2)

X Ranking of 4 programs in Mozambique with highest budget in off-grid energy[1]

NOT EXHAUSTIVE

BOT

SHS

Minigrid

Financing

- **WB:** Designing RBF program (USD $3 million targeting 18,000 HH for SHS, USD $10 million for mini-grid targeting 7,000 consumers) to be executed through FUNAE; geospatial planning tool; market assessment 3
- **Sweden (BGFA and AECF):** Looking into setting up an RBF program (BGFA) and matching grants to mini-grid, SHS and clean cooking solutions (AECF) 2
- **DFID (BRILHO):** Matching grants and RBF (SHS, mini-grid, cooking solutions) 1
- **EU:** Grants focused on Zambezia and Nampula. Possibly as compliment ary funding to BRILHO. Funding for technical assistance in matters relating to mini-grid policies. Over EUR 83 million are earmarked for increasing rural electrifica-tion, due to start 2019
- **GIZ (EnDev):** Start-up capital and RBF
- **Norwegian Embassy:** Pre-feasibility studies

Technical assistance

- **WB:** TA and capacity building for private sector (USD $3 million targeting); also developing geospatial model 3
- **DFID (BRILHO):** Awareness creation; international standards; research & dissemination; business model development, financial planning (SHS, mini-grid, cooking solutions) 1
- **GIZ (EnDev):** Awareness creation; strengthening quality standards and control
- **Netherlands:** Awareness creation (co-funders of EnDev)
- **Belgium (RERD):** Awareness creation 4

1 According to the World Bank Project Appraisal Document which states the donor programs and funding: DFID (BRILHO) with USD $30m, Embassy of Sweden with USD $17.5m, World Bank with USD $16m and Belgium (RERD) with USD $13.8m

SOURCE: World Bank 2019, Pro Energia Project Appraisal Document; DFID 2017 Energy Africa Compact; Interviews with development partners

MOZAMBIQUE PATH TO IMPACT

- Executive summary
- Electrification in Mozambique
- Structures and institutions
- **Path to impact for SAEP**
- Initiatives for SAEP Year 3
- Next steps
- Appendix

THERE ARE FOUR AREAS OF INTERVENTION TO DRIVE OFF-GRID IN MOZAMBIQUE

BASED ON MOZAMBIQUE STAKEHOLDER DISCUSSIONS

			Description
Off-Grid	Solar Home Systems (SHS)	Private	▪ **Four companies** – SolarWorks!, Epsilon, Ignite[1] and Fenix – are the main players in this under-developed market, who typically provides SHS on a pay-to-own model ▪ Total, Forsera (through Solarkom), BoP shop sell pico solar system kits
		Public	▪ **FUNAE** has distributed 920 pico solar system (PSS) kits and 1,744 large PV SHS that electrified 235 villages, 600-800 schools and 600-700 health centers
	Mini-grids	Private	▪ **Limited private sector participation** owing to current regulatory framework, but some single-connection solutions for commercial or public administration buildings[2]
		Public	▪ **FUNAE is the key player,** with 3 solar mini-grids of >350kW each, 50 4kW mini solar plants[3] and 5-60kW solar mini/micro-grids in 244 villages

1 Ignite has been awarded the contract by Government of Mozambique to electrify 1.8 million people and will be partnering with FUNAE; 2 E.g., schools, hospitals
3 Project known as "50 Vilas Solares", which electrified 50 villages with solar mini-grids; only 4 solar mini-grid pilot projects managed by FUNAE are reported to be operational

SOURCE: ALER, Renewables in Mozambique – National Status Report / October 2017; National Electrification Strategy – November 2017; Integrated Master Plan - Mozambique Power System Development – November 2018

THREE BARRIERS REQUIRE IMMEDIATE ATTENTION AND ARE ARE NOT BEING FULLY ADDRESSED

Possible areas for SAEP support | X Key barrier | ✓ Ongoing | ✓ Planned

Theme	Issue category			Barriers to scale-up	Work being done: BRILHO	WB	USAID	EnDev	DFID
SHS Private	Enabling environ-ment	Policy environment		1 Absence of (recent) commitment on the role of off-grid in national electrification plans and on willingness to create a level playing field	Planned	Planned		Ongoing	Planned
		Regulatory framework		2 Absence (or inconsistent enforcement of) quality standards leads to high defect rate and poor quality perception				Ongoing	Planned
				3 Inconsistent application of import duty exemptions drive up costs			Planned	Ongoing	Planned
				4 Incomplete exemption coverage (e.g., only applied to batteries and panels) drives up costs			Planned	Ongoing	Planned
	Support to private players	Customer ability to pay / awareness	Ability to pay	5 Consumer cannot afford the deposit fee (without up-front financing)	Planned	Planned			
				6 Consumers have periodic income streams, which limits their ability to make monthly payments					
				7 Absence of scalable mechanism to pay (e.g., mobile money)					Planned
			Aware-ness	8 Consumers are not aware of the brand and do not trust the product				Ongoing	Planned
		Supply chain and route to market (cost of remote expan-sion)	Route to market / Cost to Serve	9 Product design inefficiencies drives up manufacturing costs					
				10 Limited distribution network, due to absence of established, structured agent / dealer network drives up cost and drives down efficiency					Planned
				13 Poor credit management / conversion cycle drives inventory and working capital costs					
			Sales force effectiven ess	15 Low sales effectiveness, due to lack of apprenticeship (staff do not know how to market the product)				Ongoing	
				16 Slow talent growth, due to high churn / low talent retention					
		Access to finance	Company access to finance	17 Insufficient access to affordable debt				Ongoing	
				18 Insufficient access to equity capital					Ongoing
				19 Grant funding				Ongoing	

WHILE OTHER PROGRAMS RAMP UP, SAEP CAN IMMEDIATELY HELP SHS COMPANIES THROUGH THREE INITIATIVES

First priority | Second priority

			Intervention	Possible counterparts
SHS private	Enabling environ-ment	Institu-tional (second priority)	▪ Provide technical analysis to support the Inter-Ministerial Committee and Implementation Coordination Group (currently being established)	BGFA / REEEP, SPEED+
			▪ Monitor development of private sector associations	AMER
		Fiscal (second priority)	▪ Support processes underway to drive removal of high VAT and import duties on solar power products e.g., by optimizing positioning of the evidence to support the case and advising on the process based on lessons learned from driving exemptions in Zambia	US Embassy, SPEED+
	Support to private players	Afford-ability (first priority)	▪ Create transparency over consumer affordability e.g., via an SHS consumer survey (as deployed in Zambia)	SolarWorks!, FENIX, Ignite, Epsilon
			▪ Support BGFA in the design and planning of their RBF program, scheduled to launch in early 2020	BGFA / REEEP
		Route to market (first priority)	▪ Improve ability of SHS companies to make effective route to market decisions based on geospatial data at settlement level (including e.g., unelectrified households, travel time to major towns, access to mobile network)	SolarWorks!, FENIX, Ignite, Epsilon, new entrants
		Operatio-nal support (second priority)	▪ Provide operational support to SHS companies, based on need	SolarWorks!, FENIX, Ignite, Epsilon

+ Establish seamless coordination with other donors and institutions

MOZAMBIQUE PATH TO IMPACT

1 ROUTE TO MARKET TOOL

OBJECTIVE

To improve the ability of SHS players to make effective route to market decisions through identifying the most attractive geographic regions using geospatial analysis

INITIATIVE APPROACH

The model will combine several data layers (population, night time light emission, road networks) do develop a view of priority geographic markets based on customizable criteria (i.e., mobile money penetration and travel time to nearest major city). The model will output an Excel sheet of all defined settlements and a Google Earth file for SHS players to leverage while making route to market decisions

Quantitative analysis through a survey or developing a model	✓
Qualitative research through insight reports, consultations or workshops	✗
Brand new analysis; not augmentation or update of existing work in Mozambique	✓

KEY PARTNERS

Institution	Focus of work	Lead counterpart individual
Epsilon	Selling SHS units	Kevin Kennedy
FENIX	Selling SHS units	Luke Hodgkinson
Ignite	Selling SHS units	Pedro Coutinho
Solar Works!	Selling SHS units	Miguel Sottomayor
FUNAE	Rural electrification	Edson Uamuse

SCOPE EXCLUSIONS

- Does not validate the viability of connecting sites for SHS providers
- Will not provide a view of the relative cost of electrification for settlements compared to other technologies

MILESTONES

Milestone	Timing
Development of route to market tool	4-5 weeks
Inclusion of propriety data layers, customizations deployment to four SHS players (upon request)	2-8 weeks

1 THE RTM TOOL WILL COMBINE DATA SETS IN A SIMPLE THREE-STEP APPROACH TO DEVELOP INSIGHTS

1 Calculate total population and number of households

- Sum the **total population** from the HRSL population data-set
- **Build settlement areas** using a **bottom-up** agglomerative[1] approach
- Calculate the **population and density** of each resulting settlement
- Validate the assumption for **number of people per household** (5 people)
- Calculate the **number of households**

2 Calculate electrification rates

- Utilize nightlight dataset to categorize **areas with electricity** and **areas without electricity** access
- Calculate the **number of households in electrified and unelectrified settlements**
- Validate the electrified areas using the **proximity to transmission lines** to **validate** the categorization[2]

3 Prioritize markets based on selected criteria

- **Proximity to major hubs,** assign driving speeds to each road type, then calculate the **travel time from each settlement to the nearest major city/town/port**
- **Mobile money penetration,** overlay mobile money penetration data (if available) to **determine geographies with high mobile money penetration and low electrification**

1 An approach developed to define settlements using only the HRSL data-set without the need for a data-set of villages & cities
2 Ensured that settlements close to transmissions lines were counted as areas with access and settlements far from transmission lines were counted as areas without access

SOURCE: SAEP Malawi Route To Market Analysis

1 THE MAJORITY OF THE DATA REQUIRED TO BUILD THE TOOL IS AVAILABLE

Required data layer:	Readily available:	Data source:	Difference in modelling approach to Malawi:
Population	✓	HRSL[1] population data-set, Columbia University	Due to the granularity and nature of this data, 30mx30m forming “clusters” of built up areas, settlements can be build bottom-up
Settlements	✓	Built bottom-up from population data	Defining settlements in a bottom-up fashion using the HRSL populations data-set will result in a more granular settlement layer than the Malawi tool which used a settlement dataset at an administrative level
Roads	✓	OpenStreetMap data	Same as Malawi
Night time light emission	✓	VIIRS[2] data-set, NASA	Will not calculate % of electrified HH in a settlement, settlements will be granular enough to be classified as either fully electrified or un-electrified
Transmission line data	✓	Energydata.info[3]	Will be used to validate whether settlements are electrified or not (validation of night time light data)
Mobile network coverage	✗	Telecommunications companies	Will depend on the nature of the data sourced
Mobile money penetration	✗	Telecommunications companies; Customer affordability survey	Will depend on the nature of the data sourced
Areas of high economic activity	✓	Mozambique data portal; TBD	Will depend on the nature of the data sourced, will potentially include mining in addition to agriculture
Locations of SHS company sales force	✓	SHS companies – SolarWorks has shop addresses on its website	Will depend on the nature of the data sourced

1 High Resolution Settlement Layer; 2 Visible Infrared Imaging Radiometer Suite; 3 Potential other sources: World Bank Geo map of transmission network (2017) - may be layered on OpenStreetMap and African Energy map (2016) - charge back of $100 (just a hardcopy map)

1 THE MODEL OUTPUT WILL BE IN THE FORM OF AN EXCEL SPREADSHEET, COMBINED WITH A GOOGLE EARTH FILE

Excel file

UID	Admin level 3	Population	Pop in elect. areas
1	Chiwanga, James Silindu, J	7831	0
2	Chikombwi, Ichinga, Luwiti	8020	0
3	Mwandovi	4348	0
4	Chibweza, Dzama, Madzi,	5892	0
5	Chalonga (A), Kapuzama (	4607	0
6	Bisa, Kumangulu, Mdzinja	6030	0
7	Chambo, Kalulu	11502	4059
8	Chimwaye, Chinkhowe, M	5735	0
9	Chiwete (B), Lemwe, Mafu	5499	0
10	Chigangawa, Chitedze, Wi	7008	0
11	Chana, Chigwirizani Farm,	4150	0
12	Alemeka	5116	4682
13	Chikuta, Chipuliro, Kalima,	7154	0
14	Chankholombe, Kaphika, V	10905	0
15	Bakiele, Chilundu, Katibula	4528	0
16	Becond Farm, Gomani, Siti	7018	0

- An excel file listing **all settlements** and their **characteristics** (e.g., population, density, electrification status, mobile money penetration, travel time to Maputo etc.)

- A **Google Earth interface** allowing the user to **drag their mouse over settlements** on a map and view each settlement's characteristics

Google Earth KML files

2 CONSUMER AFFORDABILITY SURVEY

OBJECTIVE

To assist SHS companies and key development players drive SHS connections through creating transparency on consumer affordability, awareness and willingness to pay for SHS in Mozambique.

INITIATIVE APPROACH

The consumer affordability survey will provide insights into a) the monthly household expenditure on energy (candles, torch batteries, kerosene, travel) compared to local SHS price points as well as willingness to pay for SHS units, b) SHS product awareness and perception; and c) mobile phone and mobile money penetration or accessibility of any other relevant payment mechanisms. The survey will cover a sample of 2,100 households across all 10 provinces, with representation from 65% rural households and 85-90% unelectrified households, as well as a minimum of 30% women. Following the survey, detailed analysis will be conducted and a report of the insights will be compiled. This will be open source and shared with development partners, government institutions and SHS companies.

- Quantitative analysis through a survey or developing a model ✓
- Qualitative research through insight reports, consultations or workshops ✓
- Brand new analysis; not augmentation or update of existing work in Mozambique ✓

KEY PARTNERS

Institution	Focus of work	Lead counterpart individual
SHS companies[1]	Selling SHS units	Various
BGFA	Setting up an RBF program	Andreas Zahner
BRILHO	Matching grants and RBF	Martijn Veen
EnDev	Start-up capital and RBF	Rosario Fischer
World Bank	Designing RBF program	Mariano Salto
FUNAE	Rural electrification	Edson Uamuse

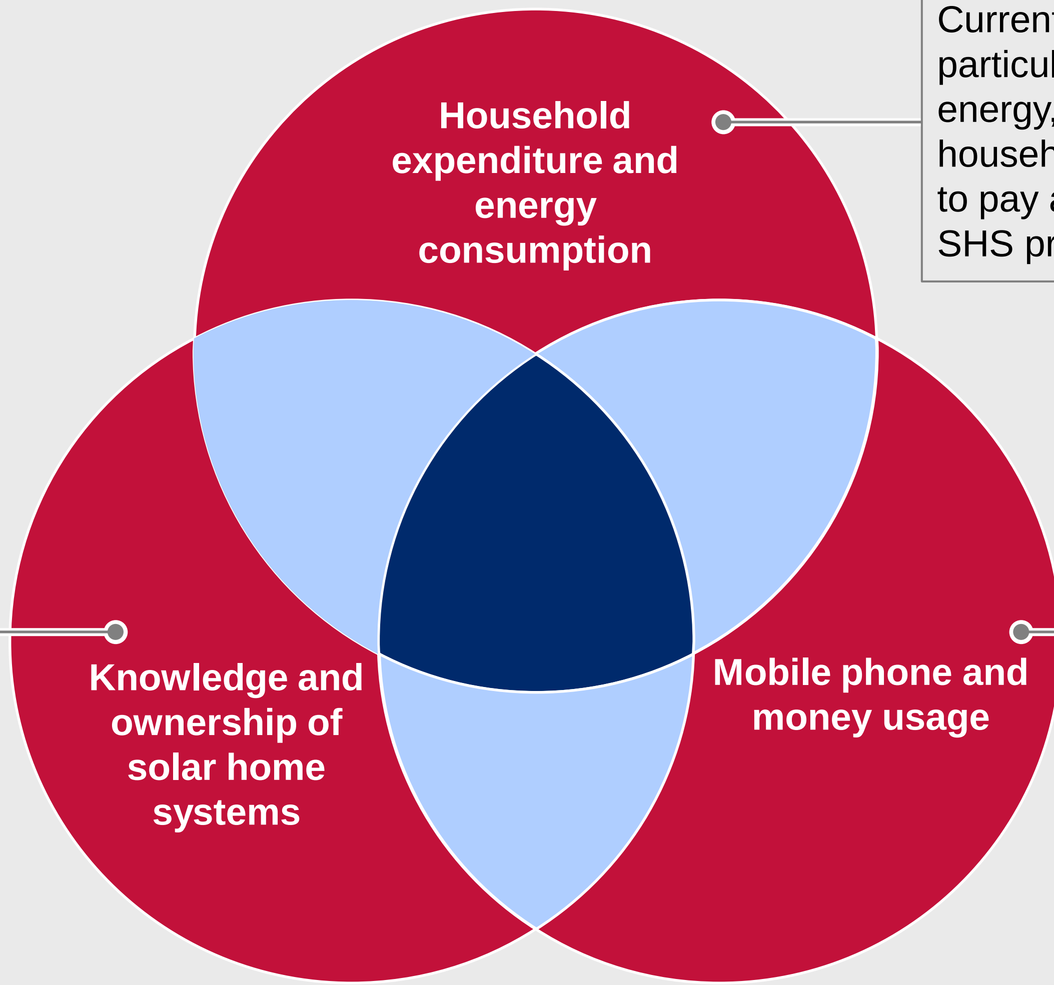
SCOPE EXCLUSIONS

- Marketing SHS products to surveyed households and communities

MILESTONES

Milestone	Timing
Design and conduct survey	2-3 months
Develop report based on survey findings	3-4 weeks

2 THE CONSUMER AFFORDABILITY SURVEY WILL ASSESS HOUSEHOLDS ON THREE DIMENSIONS



Current expenditure patterns, particularly spending on energy, indicate whether households would be willing to pay and able to afford a SHS product

Awareness of SHS, current purchasing patterns and barriers to SHS take-up provide an understanding of the current reach and appeal of the market, where varying levels of market development will require a different sales approach by SHS players

Mobile phone penetration and digital financial services uptake are key indicators of market potential for SHS companies given the ease of payment via mobile platforms

SOURCE: Internal analysis, SHS company interviews

2 THE SURVEY WILL INCLUDE ~50 QUESTIONS, SPLIT BETWEEN THESE THREE DIMENSIONS

Dimension	**SHS awareness and ownership**	**Mobile phone and money usage**	**Household expenditure and willingness to pay for SHS**
Sample questions	▪ Do people know and/or own SHS?	▪ What is the penetration of mobile phones and mobile money?	▪ What is the average household expenditure, and does it vary over time?
	▪ How do people perceive solar energy?	▪ How much do households transact on mobile money platforms?	▪ Are households able to afford SHS products?
	▪ What prevents households from purchasing SHS?		▪ How much are households willing to pay for SHS products?

2 SURVEY QUESTIONS WILL BE ADAPTED FROM THE ZAMBIA SURVEY

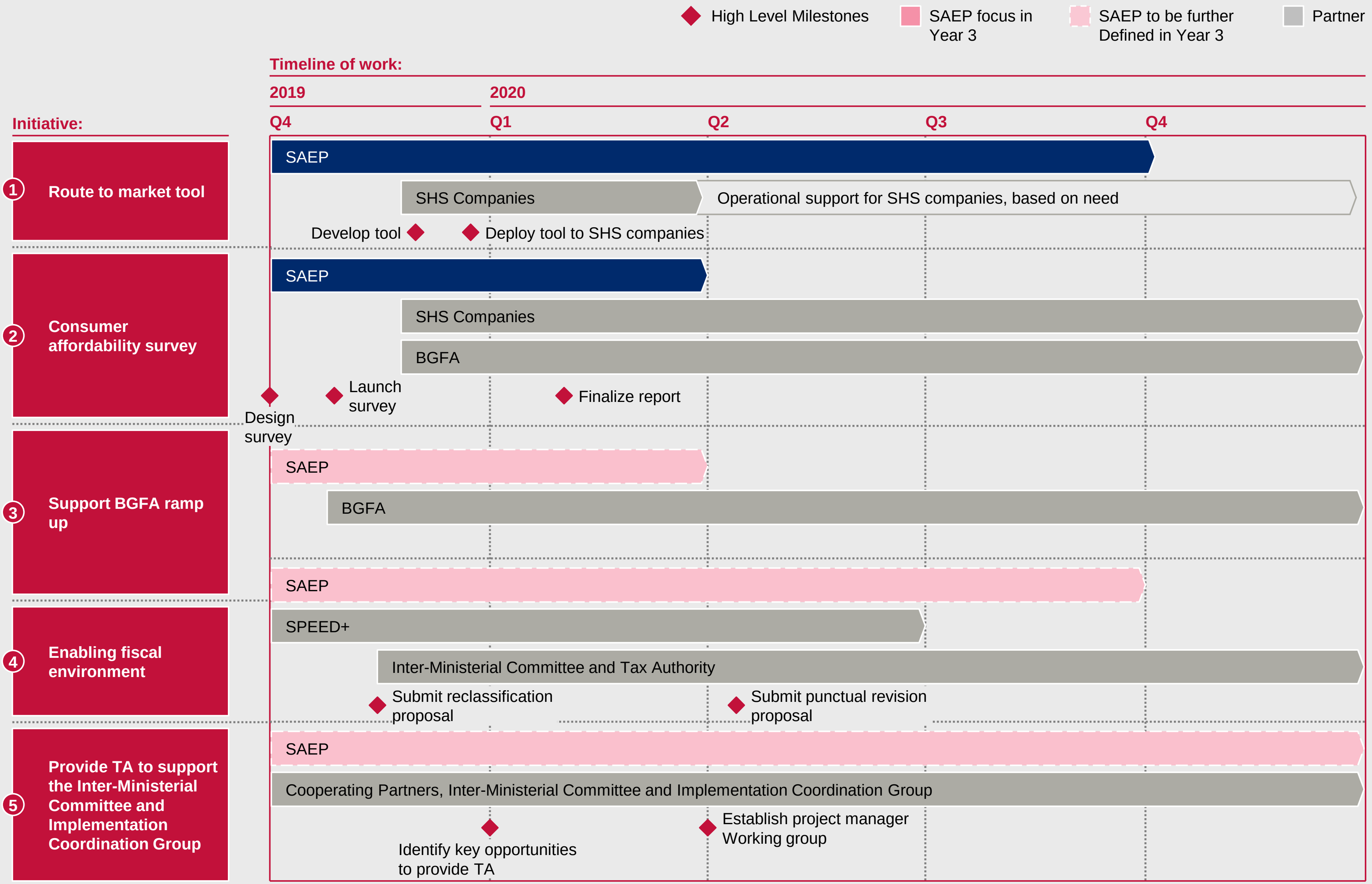
	Questions to change:	Potential change:
Questions to change	▪ Which province/city/district do you live in?	▪ The options will be specific to Mozambique (e.g., Zambezia, Nampula, Maputo)
	▪ How long does it take you to reach the nearest bank?	▪ Bank might not relevant – may only focus on mobile money and peer 2 peer services (to confirm with SHS companies)
	▪ All questions asking about spend (i.e., how much people spend on mobile money per week)	▪ The options (i.e., 10 Metical, 20 Metical) need to be relevant to the Mozambican context

	Questions to add:	Rationale:
Questions to add	▪ What type of walls/roofs does your house have? (i.e., grass/thatch, wood, metal or tile roof; mud, metal, wood, brick/stone walls)	▪ Understanding the type of building people live in can help determining their level of income
	▪ Is your income fixed or does it fluctuate ▪ How often do you receive income (weekly, monthly, quarterly)	▪ Understanding the seasonality of household income can help determine households ability to consistently pay a monthly instalment for SHS
	▪ Do you use any other forms of Peer 2 Peer (P2P) payment mechanisms? ▪ If so, how much money do you spend using these services on a weekly basis?	▪ Need to test whether there are alternative options to mobile money which could be leveraged for scale up
	▪ How many bundles of firewood do you purchase weekly? ▪ How many liters of gasoline do you purchase weekly? ▪ How much, on average, do you spend on one candle / bundle of firewood / liter of kerosene / to charge your phone in Meticals? ▪ How far do you have to travel to buy these energy products? ▪ How much do you pay for transport each time you travel to purchase wood, candles, torch batteries etc. ▪ How many lanterns do you have?	▪ Firewood and gasoline make up a significant portion of energy consumption in Mozambique ▪ Getting exact costs of a candle / bundle of firewood etc will provide more precise information about expenditure on energy ▪ It is important to consider the transport cost of travelling to purchase energy products
	▪ Do you have children? ▪ How many? ▪ How old are they? ▪ Do they go to school?	▪ Typically families who place more importance on providing education and better quality of life to their families would have a higher willingness to pay
	▪ How long does it take you to reach the nearest trading center?	▪ Understanding ease of access to goods and services for households helps in understanding financial well being

LEVERAGING LEARNINGS FROM OTHER COUNTRIES

		Work previously done in:	
Initiative	**Differences in approach**	**Zambia**	**Malawi**
1 **Route to market tool**	▪ A more granular population dataset (HRSL) will allow bottom-up definition of settlements – resulting in more granular settlement data ▪ Electrification status of settlements can then be determined at a settlement level ▪ Criteria for prioritization of geographic markets may be different (i.e., payment mechanisms other than mobile money may be assessed)	☐	☑
2 **Consumer affordability survey**	▪ Alternative payment mechanism's to mobile money may be assessed (based on desktop search of what's being used in Mozambique today ▪ Current sources of lighting will also include firewood and kerosene/gasoline ▪ Income brackets will be based on Mozambique's income distribution	☑	☐
3 **Support BGFA Ramp up**	▪ Establishing collaborative working agreement with BGFA from the beginning ▪ Focus on an RBF program from the start	☑	☐
4 **Enabling fiscal environment**	▪ All activities will have to align to the Mozambican budget cycle, which differs to Zambia	☑	☐
5 **Provide TA to support the Inter-Ministerial Committee and Implementation Coordination Group**	▪ Will have to understand the existing collaborative environment in Mozambique and to what extent improvements can be made ▪ Focus will likely be on driving the establishment of a working group of project managers to coordinate the technical implementation of initiatives	☑	☑

TIMELINE AND KEY INTERFACES WITH PARTNERS



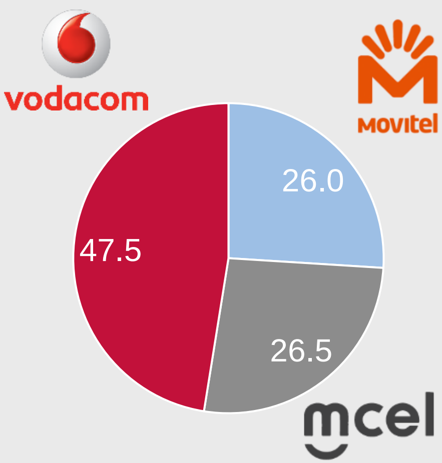
MOZAMBIQUE PATH TO IMPACT

MOBILE PHONE AND MOBILE MONEY COVERAGE IN MOZAMBIQUE ARE LOW AT 44% AND 22% RESPECTIVELY

Mobile coverage

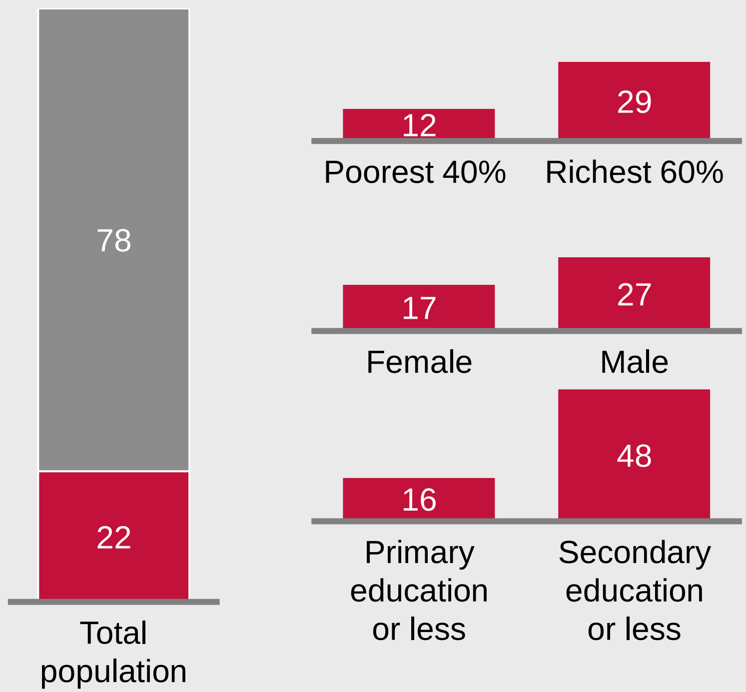
44% of Mozambique's population has **access to a mobile phone**[1]

Market share of mobile providers in Mozambique, %



Mobile money

Population with access to mobile money[2]**,** %



Mobile money providers

mkesh M-PESA

Insights

- The **population** with **mobile phones is low (44% compared** to **82%** in **Zambia** and **91%** in **Kenya**)
- The population with **access to mobile money** is **low** (**22%** compared to **28%** in **Zambia** and **73%** in **Kenya**) – this is even lower for the **rural population at 18%**

1 Q2 2019; 2 2017, age 15+

SOURCE: GSMA; Intelligence Global Findex database; Press search

THERE ARE 29 ORGANIZATIONS IN THE ENERGY SECTOR WORKING GROUP

Organization name	
1 African Development Bank	16 Japan International Cooperation Agency
2 Agence Française de Développement	17 KfW
3 AICS Maputo	18 Korea Eximbank
4 Austrian Development Agency	19 Ministry for Foreign Affairs, Finland
5 Centinos Incorporated	20 Ministry of Foreign Affairs, Japan
6 Cox Communication	21 Ministry of Foreign Affairs, Netherlands
7 Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	22 Ministry of Foreign Affairs, Norway
8 Enabel	23 Ministry of Foreign Affairs, Portugal
9 European External Action Service	24 Portail Orange
10 Federal Department of Foreign Affairs, Switzerland	25 SPEED+ Program Mozambique
11 German Federal Foreign Office	26 United Nations Industrial Development Organization
12 GET FiT Mozambique Program	27 United States Department of State
13 Global Green Growth Institute	28 USAID
14 Government of Sweden	29 World Bank
15 International Finance Corporation	

WE CONSULTED ~30 STAKEHOLDERS IN DEVELOPING THE MOZAMBIQUE SAEP PATH TO IMPACT (1/2)

Organization	Name	Title
AFD	Laurène Levy	Project Officer
EnDev/GIZ	Rosario Loayza	Program Director
Epsilon	Kevin Kennedy	Founder
Epsilon	Kathryn Larcombe	Consultant
Epsilon	Djamila Osman	Administrator
Fenix	Luke Hodgkinson	Country Lead
Fenix	Nikita Smeshko	Business Strategy manager
FUNAE	Edson Uamuse, Manager	Division of Studies and Planning
FUNAE	Filipe Mondlane, Advisor to Board of Directors	Division of Studies and Planning
FUNAE	Isália Dimene	Head of Environment Quality Division
Ignite	Pedro Coutinho	Partner & CEO, Source Capital
Ignite	Teddy Ongamo	Managing Director
Independent Consultant	Jennifer Garvey, Legal Advisor, Energy	Energy, Natural Resources and Infrastructure
KfW	Jens Dorn	Senior Project Coordinator
MIREME	Marcelina Mataveia	Deputy Director of Renewable Energy
MIREME	Dameon	Head of Renewables
REEEP	Andreas Zahner	Program Director
REEEP	Merja Laakso	Head of Programme, Southern Africa
REEEP	Boris Atanassov	Director

WE CONSULTED ~30 STAKEHOLDERS IN DEVELOPING THE MOZAMBIQUE SAEP PATH TO IMPACT (2/2)

Organization	Name	Title
SNV	Martijn Veen	Global Sector Coordinator for Sustainable Energy Markets
SOLARWORKS!	Helio Abrantes	CFO
SOLARWORKS!	Miguel Sottomayor	Country Manager
SPEED+	Matos Mathikizana	Power Portfolio Manager
USAID Mozambique	Stephen Gudz	Policy and Partnerships Leader
USAID Mozambique	Armando Abacar	Project Management Specialist (Energy)
World Bank	Claudio Miguel Jamisse Buque	Team Lead (PERIP)
World Bank, ProEnergia	Mariano Salto	Senior Energy Economist and Team Lead (PERIP)